Neuroscience

AN INTERDEPARTMENTAL MAJOR

Professor: *Beltz (Director)*

Associate Professor: *Tetel*

Assistant Professor: *Conway, Wiest*

Senior Instructor in Neuroscience
Laboratory: *Paul*

Neuroscience Advisory Committee: *Cameron (Biology), Ducas (Physics), Hildreth (Computer Science), Keane (Psychology), Kolodny (Chemistry)*

Neuroscience explores how the nervous system develops and how it functions to generate behavior, emotion and cognition. Neuroscience is highly interdisciplinary, integrating biology, psychology, chemistry, physics and computer science. Exploring the complexity of the nervous system requires analyses at multiple levels. Neuroscientists investigate how genes and molecules regulate nerve cell development and function (cellular/molecular neuroscience), explore how neural systems produce integrated behaviors (behavioral neuroscience), seek to understand how neural substrates create mental processes and thought (cognitive neuroscience) and use mathematics and computer models to comprehend brain function (computational neuroscience). In studying how the brain and nervous system function normally and during disease states, neuroscientists also hope to better understand devastating neurological and psychiatric disorders.

Goals for the Major

Create a cohesive and supportive interdepartmental community

Foster an excitement for neuroscience and an understanding of applications of neuroscience discoveries to everyday life

Appreciate the ethical complexities involved in the pursuit and application of knowledge about the brain and cognition

Cultivate an understanding of the relationships among disparate subfields that comprise neuroscience, including cellular and molecular, cognitive, computational and systems neuroscience

Develop the ability to read and critically evaluate the neuroscience literature

Acquire confidence and fluency with oral and written communication

Generate a facility with the major experimental methods and techniques used by neuroscientists, including

–electrophysiology
–computational modeling
–neurochemistry
–neuropharmacology
–neuranatomy
–genomics
–behavioral approaches

Master analytical and statistical methods critical to the evaluation of experimental data

Encourage an environment supportive of student involvement in neuroscience research

We anticipate that fulfillment of these goals will provide the intellectual and technical skills necessary for the successful pursuit of graduate school, medical school and careers in neuroscience-related fields.

NEUR 100 Brain, Behavior, and Cognition: An Introduction to Neuroscience
Conway, Tetel, Paul
This course will provide a broad introduction to neuroscience, focusing on examples and approaches from cellular and molecular, cognitive, behavioral, systems and computational neuroscience. The lecture aspect of the course will be accompanied by a 70-minute practicum in which students will engage directly in experimental neuroscience.

Prerequisite: Open only to first years and sophomores, or by permission of instructor.
Distribution: Epistemology and Cognition or Natural and Physical Science
Semester: Fall, Spring Unit: 1.0

NEUR 200 Neurons, Networks, and Behavior with Laboratory
Wiest, Paul, Helluy (Biological Sciences)
This course will build on basic concepts in neuroscience. Current issues will be examined within a broad framework that includes examples and readings in cellular and molecular, cognitive, behavioral and computational neuroscience. Topics such as sensory systems, learning, memory, and cognition will be covered. The accompanying laboratory is designed to expose students to basic methods and experimental approaches in neuroscience.

Prerequisite: 100 and BISC 110 or permission of instructor. Not open to first-year students.
Distribution: Epistemology and Cognition or Natural and Physical Science
Semester: Fall, Spring Unit: 1.25

NEUR 250 Research or Individual Study

Prerequisite: By permission of instructor.
Distribution: None
Semester: Fall, Spring Unit: 1.0

NEUR 250H Research or Individual Study

Prerequisite: By permission of instructor.
Distribution: None
Semester: Fall, Spring Unit: 0.5

NEUR 300 Capstone Seminar in Neuroscience

Beltz, Conway

In this capstone seminar for senior neuroscience majors, students will give group presentations of articles on cutting edge areas of neuroscience research. The authors of these articles will be invited to campus to present their research and meet with the class. Some of the topics to be discussed include: developmental neuroscience, computational and systems neuroscience, cognitive neuroscience, learning and memory and neurodegenerative disorders. In addition, careers in neuroscience will be discussed.

Prerequisite: 200 or [NEUR 213/BISC 213]. Open only to neuroscience majors.
Distribution: Epistemology and Cognition or Natural and Physical Science
Semester: Spring Unit: 1.0

NEUR 306/BISC 306 Principles of Neural Development with Laboratory

Beltz, Paul

This course will discuss aspects of nervous system development and how these relate to the development of the organism as a whole. Topics such as neural induction, neurogenesis, programmed cell death, axon guidance, synaptogenesis and the development of behavior will be discussed, with an emphasis on the primary literature and critical reading skills. Laboratory sessions focus on a variety of methods used to define developing neural systems. *Students may register for either NEUR 306 or BISC 306 and credit will be granted accordingly.*

Prerequisite: 200 or [NEUR 213/BISC 213] or BISC 216 or permission of instructor.
Distribution: Epistemology and Cognition or Natural and Physical Science
Semester: Spring Unit: 1.25

NEUR 315/BISC 315 Neuroendocrinology with Laboratory

Tetel

Hormones act throughout the body to coordinate basic biological functions such as development, differentiation and reproduction. This course will investigate how hormones act in the brain to regulate physiology and behavior. We will study how the major neuroendocrine axes regulate a variety of functions, including brain development, reproductive physiology and behavior, homeostasis and stress. The regulation of these functions by hormones will be investigated at the molecular, cellular and systems levels. Laboratory experiments will explore various approaches to neuroendocrine research, including the detection of hormone receptors in the brain and analysis of behavior. *Students may register for either NEUR 315 or BISC 315 and credit will be granted accordingly.*

Prerequisite: 200 or [NEUR 213/BISC 213], or both BISC 110 and BISC 203, or permission of instructor.
Distribution: Epistemology and Cognition or Natural and Physical Science
Semester: Fall Unit: 1.25

NEUR 320 Vision and Art: Physics, Physiology, Perception, and Practice with Laboratory

Conway

This course will investigate the form and function of the human visual system by considering a unique product of this system: visual art. The course will examine the nature of the physical stimulus to which the visual system is responsive, the physiological mechanisms that capture this signal and convert it into perception, and how this process is revealed in the practice of art. As part of laboratory exercises investigating the resolution and sensitivity of your own visual system, a discipline called psychophysics, students will engage in making their own art and will learn to articulate the mechanisms by which they do so. The interdisciplinary nature of the course will require an advanced level of student participation, commitment, and self-directed learning.

Prerequisite: 100 or by permission of instructor.
Distribution: Epistemology and Cognition or Natural and Physical Science
Semester: Fall Unit: 1.25

NEUR 332 Advanced Topics in Neuroscience

Beltz

Topic for 2009-10: Neuroscience and the Law. This course will examine how the field of neuroscience impacts legal decision-making, including aspects of neuroethics. Advances in neuroimaging and physiological techniques now allow us to assess mental states in a variety of circumstances. With increasing frequency, these data are presented to the courts to challenge a defendant's competency or culpability in criminal cases, or to establish grounds for injury claims in civil suits. Legal proceedings often include evidence that an individual's brain is not functioning within the "normal" limits, or claims that brain-wave patterns can distinguish deceit from truth. Discussion topics will include an examination and assessment of current neuroimaging and neurophysiological techniques. Can these methodologies realistically define "normal" brain activity? Are neuroimaging methods that purport to reveal our thoughts or behavioral tendencies an encroachment on our civil liberties? Ultimately, we will ask whether neuroscience discoveries can transform the law by redefining "free will" and "responsibility."

Prerequisite: 200 or [NEUR 213/BISC 213] or by permission of the instructor. Not open to first year students.
Distribution: Epistemology and Cognition or Natural and Physical Science
Semester: Fall Unit: 1.0

NEUR 335 Computational Neuroscience with Laboratory

Wiest

The electrical activities of neurons in the brain underlie all of our thoughts, perceptions, and memories. However, it is difficult to measure these neural activities experimentally, and also difficult to describe them precisely in ordinary language. For this reason, mathematical models and computer simulations are increasingly used to bridge the gap between experimental measurements and hypothesized network function. This course will focus on the use of mathematical models and computer simulations to describe the functional dynamics of neurons in a variety of animals. Topics will range from single neuron biophysics to the analysis of circuits thought to underlie sensory perception and memory. Topics will be introduced by background lectures, followed by student-led presentations of primary literature and construction of a computer model of the system studied. Lab will introduce students to computer programming of mathematical models in MATLAB and the neuron-simulator NEURON.

Prerequisite: 200 or [NEUR 213/BISC 213] and calculus at the level of MATH 115, or by permission of instructor. No programming experience is required.
Distribution: Natural and Physical Science or Mathematical Modeling
Semester: Spring Unit: 1.25

NEUR 350 Research or Individual Study

Prerequisite: Open by permission to juniors and seniors.
Distribution: None
Semester: Fall, Spring Unit: 1.0

NEUR 350H Research or Individual Study

Prerequisite: Open by permission to juniors and seniors.
Distribution: None
Semester: Fall, Spring Unit: 0.5

NEUR 360 Senior Thesis Research

Prerequisite: By permission of the Program. See Academic Distinctions.
Distribution: None
Semester: Fall, Spring Unit: 1.0

NEUR 370 Senior Thesis

Prerequisite: 360 and permission of the Program.
Distribution: None
Semester: Fall, Spring Unit: 1.0

Requirements for the Major

For students who entered the College in the fall of 2007 or 2008, the major in neuroscience offers three areas of concentration: cellular and molecular neuroscience, cognitive neuroscience, and systems and computational neuroscience. Students are expected to achieve competence in two of these three areas. The major must include the following core courses: NEUR 100, 200 and 300 and PSYC 205. Majors must elect three 200-level courses from two of the three areas of concentration: Cellular and molecular neuroscience: BISC 219, 220, CHEM 211, 221 or 222; Cognitive neuroscience: PSYC 214, 215, 216, 217; Systems and computational neuroscience: CS 232, MATH 215, PHYS 216, 219, 222. Note that these 200-level courses have specific prerequisites that must be satisfied. Majors must also elect three 300-level courses from two of the three areas of concentration, at least one of which must be a laboratory course: Cellular and molecular neuroscience: NEUR/BISC 306, NEUR/BISC 315, NEUR 332, BISC 302, CHEM 306 (only when neuroscience-related topics); Cognitive neuroscience: NEUR 332 (F09), PSYC 304R, 314R, 315, 316, 318, 319, 328; Systems and computational neuroscience: NEUR 320, NEUR 335, CS 332. Any other 300-level courses must be specifically approved by the Director. NEUR 250, 250H, 350, 350H, 360 and 370 do not count towards the minimum major. A minimum of eight courses towards the major requirements must be taken at Wellesley. Additional information is also available on the Web at http://www.wellesley.edu/neuroscience/major_complete.html.

For students who enter the College in the fall of 2009 or later, the major in neuroscience is the same as for those entering in 2007 and 2008, but also includes BISC 110.

For students who entered the College prior to the fall of 2007, a major in neuroscience must include the following core courses: BISC 110, 111; CHEM 105 (or 120), and 211; PSYC 101 and 205, and [BISC 213]. Majors must elect two 200-level courses from among the following: one from BISC 219, 220, CHEM 221 or 222; and one from PSYC 214, 215, 216, 217. In addition, majors must elect two 300-level courses, at least one of which must be a laboratory course. Acceptable 300-level courses are BISC 302; CHEM 306 (only when neuroscience-related topics); CS 332; NEUR/BISC 306, 315; NEUR 300, 320, 332, 335; PSYC 304R, 314R, 315, 316, 318, 319, 328. Any other 300-level courses must be approved specifically by the director. NEUR 250, 250H, 350, 350H, 360 and 370 do not count towards the minimum major. A minimum of six courses (a minimum of 6.75 units) towards the major requirements must be taken at Wellesley.

Normally no more than three units in neuroscience taken at other institutions may be counted towards the major.

Transfer Credit

To obtain Wellesley credit for any neuroscience course taken at another institution, preliminary approval must be obtained from the director of the program prior to enrolling in the course. In general, courses taken at two-year colleges will not be accepted. These restrictions apply to courses taken after enrollment at Wellesley. Transfer students wishing to obtain credit for courses taken prior to enrollment at Wellesley should consult the program director.

Honors

Senior thesis (NEUR 360/370) projects may be supervised by members of the various departments associated with the major. Students considering the senior thesis option are advised to consult with the director of the program during the fall of their junior year.

Graduate Study

Students wishing to attend graduate school in neuroscience are strongly encouraged to take CHEM 211/212, CS 112, MATH 115/116 and physics through PHYS 106 or PHYS 108.